CE205 Data Structures Week-10

Sorting Algorithms, Taxonomy and Comparisons

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# CE205 Data Structures

# Week-10

### Advaced Tree Data Structures (Binary Search Tree, AVL Tree, B Trees and derivations,Red-Black trees, Splay Trees and Augmented Data Structures, van Emde Boas Trees, Binomial and Minimax Trees ) and Comparisons.

Download [DOC](ce205-week-10-advanced-tree-structures.md_doc.pdf), [SLIDE](ce205-week-10-advanced-tree-structures.md_slide.pdf), [PPTX](ce205-week-10-advanced-tree-structures.md_slide.pptx)

### Outline

* Trees
  + Binary Search Tree
    - Search and Insertion
    - Delete
    - BST over Hash Table
    - Construction and Conversions
    - Check Smallest/Largest Element

### Outline

* Trees
  + Red Black Tree and Threaded Binary Tree
  + AVL Trees
  + B Trees
    - Defitinion of B Trees
    - Basic operations on B tree
    - Deleting a key from a B tree
  + 2 3 4 Trees
  + 2 3 Trees
  + B+ Trees

### Outline

* Trees
  + R Trees
  + Red - Black Tree Datastructure
  + Splay Tree Datastructure
  + Augmenting Data Structures
    - Dynamic order statistics
    - How to augment a data structure

### Outline

* Trees
  + Interval trees
  + van Emde Boas Trees
    - Preliminary approaches
    - A recursive structure
    - The van Emde Boas tree
  + Binomial Trees
  + Comparison of Search Trees
  + Minimax Tree

### Binary Search Tree

* http://www.btechsmartclass.com/data\_structures/binary-search-tree.html
* https://visualgo.net/en/bst?slide=1 (Select BINARY SEARCH TREE)
* https://www.cs.usfca.edu/~galles/visualization/BST.html
* Search and Insertion
* Delete

### BST over Hash Table

* https://www.geeksforgeeks.org/advantages-of-bst-over-hash-table/?ref=lbp
* Construction and Conversions
* Check Smallest/Largest Element

### Red Black Tree and Threaded Binary Tree

* https://www.geeksforgeeks.org/threaded-binary-tree/

### AVL Trees

* http://www.btechsmartclass.com/data\_structures/avl-trees.html
* https://visualgo.net/en/bst (Select AVL)
* https://www.cs.usfca.edu/~galles/visualization/AVLtree.html

### B Trees

* http://www.btechsmartclass.com/data\_structures/b-trees.html
* https://www.cs.usfca.edu/~galles/visualization/BTree.html

### Defitinion of B Trees

* https://www.geeksforgeeks.org/introduction-of-b-tree-2/

#### Basic operations on B tree

* https://www.geeksforgeeks.org/insert-operation-in-b-tree/
* https://www.guru99.com/b-tree-example.html

#### Deleting a key from a B tree

* https://www.geeksforgeeks.org/delete-operation-in-b-tree/

### 2 3 4 Trees

* https://en.wikipedia.org/wiki/2%E2%80%933%E2%80%934\_tree

### 2 3 Trees

* https://en.wikipedia.org/wiki/2%E2%80%933\_tree

### B+ Trees

* https://www.geeksforgeeks.org/introduction-of-b-tree/
* https://www.cs.usfca.edu/~galles/visualization/BPlusTree.html
* https://www.geeksforgeeks.org/difference-between-b-tree-and-b-tree/?ref=rp

### R Trees

* https://www.geeksforgeeks.org/introduction-to-r-tree/?ref=rp

### Red - Black Tree Datastructure

* http://www.btechsmartclass.com/data\_structures/red-black-trees.html
* https://www.geeksforgeeks.org/red-black-tree-set-1-introduction-2/?ref=rp
* https://www.geeksforgeeks.org/red-black-tree-set-2-insert/
* https://www.geeksforgeeks.org/red-black-tree-set-3-delete-2/

### Splay Tree Datastructure

* http://www.btechsmartclass.com/data\_structures/splay-trees.html
* https://www.geeksforgeeks.org/splay-tree-set-1-insert/?ref=rp
* https://www.geeksforgeeks.org/splay-tree-set-2-insert-delete/
* https://www.geeksforgeeks.org/splay-tree-set-3-delete/?ref=rp

### Augmenting Data Structures

* http://cs.bilkent.edu.tr/~ugur/teaching/cs502/material/cs502\_2\_ADS.pdf
* https://iq.opengenus.org/augmented-data-structures/
* http://staff.ustc.edu.cn/~csli/graduate/algorithms/book6/chap15.htm
* http://www.facweb.iitkgp.ac.in/~sourav/Lecture-11.pdf

### Dynamic order statistics

* http://www.facweb.iitkgp.ac.in/~sourav/Lecture-11.pdf

### How to augment a data structure

* http://www.facweb.iitkgp.ac.in/~sourav/Lecture-11.pdf

### Interval trees

* https://www.geeksforgeeks.org/interval-tree/

### van Emde Boas Trees

* https://www.geeksforgeeks.org/van-emde-boas-tree-set-1-basics-and-construction/
* https://web.stanford.edu/class/archive/cs/cs166/cs166.1146/lectures/14/Small14.pdf
* Preliminary approaches
* A recursive structure

### Binomial Trees

* https://www.geeksforgeeks.org/binomial-heap-2/#:~:text=What%20is%20a%20Binomial%20Tree,as%20leftmost%20child%20or%20other.

### Comparison of Search Trees

* http://www.btechsmartclass.com/data\_structures/comparison-of-search-trees.html

### Minimax Tree

* https://www.geeksforgeeks.org/minimax-algorithm-in-game-theory-set-1-introduction/